United States
Department of
Agriculture

**Forest
Service**

Southwestern
Region

Forest Pest Management Report

R-3 90-9

ANNUAL SOUTHWESTERN REGION
PEST CONDITIONS REPORT
1989

JUNE 1990

3420

R-3 90-9

ANNUAL SOUTHWESTERN REGION PEST CONDITIONS REPORT 1989

JUNE 1990

By

Jill L. Wilson
Mary Lou Fairweather

USDA Forest Service, Southwestern Region
State and Private Forestry
Forest Pest Management
517 Gold Avenue, SW
Albuquerque, New Mexico 87102

FOREST PEST MANAGEMENT STAFF

REGIONAL OFFICE

Douglas L. Parker, Deputy Director

Andrea Hendrix, Chief Clerk

Pam Wood, Clerk-Typist

Assistant Director (Vacant)

Pesticide-Use Management & State Cooperative Programs (Vacant)

ARIZONA ZONE

Borys Tkacz, Arizona Zone Leader

Jill Wilson, Pest Management Specialist

Mary Lou Fairweather, Pest Management Specialist

NEW MEXICO ZONE

Dayle Bennett, New Mexico Zone Leader

Terrence J. Rogers, Pest Management Specialist

David Conklin, Pest Management Specialist

John M. Chavez, Biological Technician

Richard Norris, Biological Technician

CONTENTS

FOREWARD 1

ACKNOWLEDGEMENTS 1

CONDITIONS IN BRIEF. 2

ENTOMOLOGY

Bark beetles 3
Engraver beetle 3
Western pine beetle 5
Mountain pine beetle. 5
Spruce beetle 5
Defoliators and Other Foliage Feeders. 6
Western spruce budworm 6
Ponderosa pine needleminer. 7
Pinyon needleminer. 7
White fir needleminer 7
Pinyon needle scale 7
Other Insects. 8-9

PATHOLOGY

Stem and branch diseases 10
Root diseases. 10
Foliage diseases 12
Abiotic damage 12
Nursery diseases 12

PEST COMPLEXES

Aspen defoliators. 15
Douglas-fir mortality. 15
True fir mortality 15

FOREST PEST MANAGEMENT ACTIVITIES IN 1989. 16-17

RECENT PUBLICATIONS. 18

FOREWARD

This publication reports the status of major insects and diseases on Southwestern forests in 1989. Much of the information presented in this publication is based on aerial and ground surveys conducted by Forest Pest Management (FPM) Specialists, Southwestern Region, and State Pest Management Specialists of the Division of Forestry, Arizona State Land Department, and the New Mexico Department of Agriculture. These surveys report short-term changes in pest activity as well as indicating long-term trends when compared to previous surveys. Both types of information may be of interest and importance to National Forest, other Federal, State, and private forest land managers.

As in the past, FPM has compiled the information for lands of all ownerships; if required, further information and additional copies of this publication are available upon request.

ACKNOWLEDGEMENTS

We thank Robert Cain, Extension Forest Entomologist, New Mexico State University Cooperative Extension Service; and Robert Celaya, Forest Pest Specialist, Arizona State Land Department, for their input to this report.

CONDITIONS IN BRIEF

In the Southwest, bark beetle activity increased approximately 70 percent from 13,235 acres in 1988 to 22,525 acres in 1989. Tree volume losses resulting from bark beetle attacks in 1989 approximated 1.4 million cubic feet compared to 1.2 million cubic feet in 1988. Within the ponderosa pine forest type, pine engraver beetles continued to cause the greatest volume loss (716,310 cubic feet) followed by the western pine beetle (317,500 cubic feet), and mountain pine beetle (68,500 cubic feet). In the mixed conifer and spruce-fir forest types, the Douglas-fir beetle and true fir beetles caused 205,000 and 85,000 cubic feet of volume loss, respectively, while the spruce beetle caused 46,750 cubic feet of volume loss.

The total acreage affected by defoliators and other foliage feeding insects decreased in 1989 to approximately 149,430 acres from 491,115 acres in 1988. In mixed conifer forests, western spruce budworm defoliation decreased dramatically from 483,390 acres in 1988 to 90,800 acres in 1989. Defoliation by white fir needle miner increased slightly to 1,960 acres from 1,675 acres in 1988. The total acreage of ponderosa pine defoliated increased to 54,350 acres in 1989. Ponderosa pine needleminer was responsible for 53,600 acres of this defoliation. Pandora moth defoliated 720 acres.

Aspen defoliation resulting from an insect and disease complex comprised of the large aspen tortrix and marssonina leaf spot disease was widely scattered throughout the Region totaling 19,060 acres.

The dwarf mistletoes continued to cause significant decreases in yield in both the mixed conifer and ponderosa pine forest types. Chihuahua pine mortality was observed on 1,735 acres on the Coronado National Forest. This was due to high levels of dwarf mistletoe infection and severe moisture stress.

Root and butt rots also are important damaging agents in the Southwestern Region. Two root rotting agents are primarily responsible; Armillaria sp. and Heterobasidion annosum. They occur primarily in mixed conifer and spruce fir cover types.

ENTOMOLOGY

BARK BEETLES

The acreage of mortality attributed to bark beetles increased approximately 70 percent from 13,230 in 1988 to 22,525 acres in 1989. Volume losses increased from approximately 1.2 million cubic feet in 1988 to 1.4 million cubic feet in 1989. Greatest losses occurred in ponderosa pine, with 18,625 acres or 1.1 million cubic feet affected. This increase was not surprising given the severe drought experienced in the Region in 1989. Losses within the spruce type increased to 780 acres in 1989 but are still at low levels. Mortality caused by Douglas-fir beetle, western balsam bark beetle, and fir engraver usually occur in combination with other agents and are discussed under Pest Complexes.

Engraver Beetles, *Ips* species

Trees killed	1988	20,400
	1989	23,875

Acreage of engraver beetle activity increased substantially in ponderosa pine in many areas in 1989: 12,300 acres were attacked in 1989, while 4,990 acres were killed in 1988. Most of the mortality occurred in Arizona and over half occurred on the Fort Apache Indian Reservation (7,880 acres). Two very large mortality centers were detected in the Turkey Creek drainage, southeast of White River. Dry weather in combination with presence of dwarf mistletoe are suspected to have precipitated this outbreak. Increased activity was also observed on the San Carlos Indian Reservation (1,260 acres), and Coconino (980 acres) and Kaibab (725 acres) National Forests. Mortality on the latter two Forests were concentrated in two areas: Buck Mountain on the Coconino National Forest and Kendricks Peak on the Kaibab National Forest. A combination of drought, thinning activity, and in some cases, the presence of dwarf mistletoe are believed to have initiated the engraver beetle activity in both of those areas. Other *Ips*-related tree mortality on the Apache-Sitgreaves (90 acres), and Tonto (47 acres) National Forests consisted of widely scattered single tree and small group (less than ten trees) losses. In New Mexico, mortality consisting of scattered individual tree and small group tree mortality was detected on the Lincoln, Carson, Cibola, Gila, and Santa Fe National Forests; and the Isleta Pueblo, Mescalero-Apache, and Taos Pueblo Indian Reservations. Scattered activity continued throughout the northern part of New Mexico on State and private land. Some mortality also occurred in conjunction with thinning activities in Lincoln and Sandoval Counties, and in nursery stock in Albuquerque and Santa Fe. Volume losses Regionwide approximated 716,310 cubic feet. Several species of pine engraver beetles attack down and standing ponderosa pines in the Southwest. Two typical signs of infestation are shown (Figures 1 and 2).

Figure 1. Ponderosa pine tree top-killed by engraver.

Figure 2. Engraver beetle egg and larval galleries.

Western Pine Beetle, Dendroctonus brevicomis

Trees killed	1988	4,550
	1989	6,350

The acreage of ponderosa pine killed by western pine beetle increased almost 80 percent in 1989 to cover 4,630 acres. Over one third of the affected acreage (1,675 acres) occurred on the Tonto National Forest in Arizona, primarily on the Globe and Pleasant Valley Ranger Districts. It was the second year of significant mortality for the Pleasant Valley Ranger District. Most of the activity is occurring on poor rocky sites in the Sierra Ancha Mountains. Dwarf mistletoe is also prevalent in many areas. Significant mortality was also detected on the Fort Apache and San Carlos Indian Reservations where 975 and 950 acres were killed. Individual tree and small group mortality also occurred on the Prescott (325 acres), Coconino (75 acres), Coronado (180 acres), and Apache-Sitgreaves (65 acres) National Forests in Arizona, as well as, on the Gila (270 acres) and Lincoln (130 acres) National Forests in New Mexico. In many areas, this insect attacked in conjunction with engraver beetles. Volume losses Regionwide approximated 317,500 cubic feet.

Mountain Pine Beetle, Dendroctonus ponderosae

Trees killed	1988	1,660
	1989	1,370

The mountain pine beetle continued to cause low level mortality of ponderosa pine in the Southwest in 1989. The estimated affected acreage decreased from 1,530 acres in 1988 to 913 acres in 1989. The majority of this mortality occurred at Grand Canyon National Park (550 acres), and on the North Kaibab Ranger District (250 acres) of the Kaibab National Forest in northern Arizona. Within the Park, two main concentrations of mortality were detected, one along Point Sublime and the other near South Big Spring. The mortality at Point Sublime consisted mostly of scattered single trees and small groups and was associated with fire damage. The mortality on the North Kaibab Ranger District consisted largely of scattered single trees. Most of the trees examined had been weakened by a variety of factors including, drought, old age, and root disease. In New Mexico, widely scattered mortality was detected on the Carson (52 acres) and Santa Fe (32 acres) National Forests. Some mortality was also noted on state and private lands. Volume losses Regionwide approximated 68,500 cubic feet.

Spruce Beetle, Dendroctonus rufipennis

Trees killed	1988	110
	1989	935

The amount of spruce beetle-caused mortality remained low throughout the Southwest with only 780 acres detected. Most of the mortality occurred in northern New Mexico on the Carson National Forest (680 acres). Some scattered individual and small group tree mortality occurred on the Apache-Sitgreaves and Kaibab National Forests and Grand Canyon National Park in Arizona as well as the

Santa Fe National Forest in New Mexico. Volume losses Regionwide approximated 46,750 cubic feet.

DEFOLIATORS

The total acreage affected by defoliators decreased in 1989 to approximately 149,430 acres from 491,830 acres in 1988. Over half of the defoliation detected was caused by western spruce budworm, however, the amount defoliated in 1989 was much reduced from that noted in 1988. The amount of ponderosa pine defoliated increased in 1989 to 54,340 acres. None was detected in 1988. Ponderosa pine needleminer was responsible for most of this defoliation.

Western Spruce Budworm, *Choristoneura occidentalis*

Acres defoliated	1988	483,390
	1989	90,800

Western spruce budworm defoliation decreased over 5-fold Regionwide from 483,390 acres in 1988 to 90,800 acres in 1989. The most extensive areas of defoliation continued to occur in northern New Mexico on the Carson (33,800 acres) and Santa Fe (14,400 acres) National Forests and adjacent nearby state and private ownerships (39,520 acres). Less extensive areas of defoliation also occurred on the Apache-Sitgreaves (720 acres) National Forest, Arizona; and Cibola (200 acres) and Gila (1560 acres) National Forests, and Mescalero-Apache (600 acres) Indian Reservation, New Mexico. Radial incremental growth loss was conservatively estimated at 638,660 cubic feet.

Table 1. Acres of western spruce budworm defoliation by ownership and intensity of defoliation, Southwestern Region, 1989.

Land Ownership Class	Light	Moderate	Heavy	Total
National Forest	42,360	8,320	0	50,680
Other Federal[1]	600	0	0	600
Private	26,880	12,640	0	39,520
Total	69,840	20,960	0	90,900

[1] Includes lands administered by the National Park Service, Bureau of Indian Affairs, Bureau of Land Management, and Department of Defense.

Ponderosa Pine Needleminer, Coleotechnites ponderosae

Acres defoliated	1989	53,600

In 1989, 53,600 acres of ponderosa pine on private lands in New Mexico were infested with this tiny moth's larvae. Small infestations of this pest were first noticed south of Las Vegas, New Mexico, in 1987. It has been a chronic urban pest in the Los Alamos Area. The current outbreak became noticeable last spring and was centered in the Mineral Hill area of San Miguel County. Damage was evident from the ground and by air as a brown cast to the entire crown. In Arizona, defoliation continued to occur in the east Flagstaff, and Show-Low - Lakeside - Pinetop areas. In addition, some heavy defoliation was observed in the Clear Creek Pines subdivision near Strawberry. A new infestation area was found in the Hualapai Mountains southeast of Kingman. Serious damage does not usually result from feeding caused by this insect.

Pinyon Needleminer, Coleotechnites edulicola

Acres infested	1988	3,000
	1989	2,000

Populations of this insect have been declining since 1985. In 1989, 2,000 acres of pinyon pine on state and private lands were infested in the vicinity of Santa Fe and Tres Piedras, New Mexico. Branch, limb, and some tree mortality has occurred, but most trees appear to be recovering.

White Fir Needleminer, Epinotia meritana

Acres defoliated	1988	1,675
	1989	1,960

This insect continued to cause moderate to heavy defoliation to white fir on the North Kaibab Ranger District of the Kaibab National Forest, Arizona, for the third consecutive year. The infested area lies to the south and east of Jacob Lake. Approximately 1,960 acres were defoliated in 1989 compared to 1,675 acres in 1988 and 1,120 acres in 1987. This outbreak may result in top-killing, branch-killing, growth loss, and some tree mortality if it persists. In addition, some needle dieback caused by true fir needle cast, Lirula abietis-concoloris was observed in the area.

Pinyon Needle Scale, Matsucoccus acalyptus

Acres defoliated	1988	350
	1989	350

In New Mexico, about 350 acres of pinyon pine on private land were defoliated near El Rito and Willard. Scale activity was also detected again in the Prescott area in Arizona.

Table 2. Status of Other Insects in the Southwest, 1989

Insect	Host	Location	Remarks
Prescott scale *Matsucoccus vexillorum*	Ponderosa pine	Arizona	Twig and branch dieback caused by Prescott scale increased on the Chevelon Ranger District, Apache-Sitgreaves National Forests. Scattered damage to seedlings, saplings, and pole-sized ponderosa pines was found across 74,000 acres.
Douglas-fir tussock moth *Orgyia pseudotsuga*	Douglas-fir White fir	New Mexico	Damage to ornamental spruce, fir, and Douglas-fir decreased in Santa Fe, White Rock, and Los Alamos, and remained at low levels in Espanola, Raton, and Cedar Crest. Damage was reported on several trees in El Rito.
Tiger Moth *Halisidota* sp.	Ponderosa pine	Arizona	Tents created by tiger moth larvae were reported throughout the ponderosa pine type in Arizona. This insect generally causes only minor defoliation.
Gypsy Moth *Lymantria dispar*	Many	New Mexico	Two male gypsy moths were caught in New Mexico. One was found in McKinley County's Red Rock State Park and the other in Rio Rancho, Sandoval Co., in traps placed by USDA APHIS. The last gypsy moth detected in New Mexico was 1984 in Roswell.
Pitch nodule moth *Petrova* sp.	Pinyon	New Mexico	High populations of pitch nodule moths were detected on pinyon in several sections near Pietown west of Socorro. Larvae were found to be heavily parasitized by wasps in the genus *Hyssopus* (Hymenoptera: Eulophidae)
Twig beetles *Pityophthorus* spp.	Ponderosa pine Pinyon pine	New Mexico	Twig beetles caused considerable damage to ornamental ponderosa and pinyon trees throughout New Mexico. Balled and burlapped trees were particularly susceptible.
Oyster shell scale	Aspen	Arizona	Damage to ornamental aspen has become very noticeable in Flagstaff and Pinetop. Feeding causes branch dieback and eventually death of infested trees.

Table 2. Status of Other Insects in the Southwest, 1989--Continued

Insect	Host	Location	Remarks
Spider mite	Various ornamentals	Arizona	Infestations were reported in the Payson area on cypress, Douglas-fir, and junipers in June, 1989. Hot dry weather usually encourages proliferation of mites.
Pine needle sheath miner *Zellaria haimbachi* and Pine Sawfly *Diprion* spp.	Ponderosa pine	Arizona	Defoliation continued on ponderosa pines in the east Flagstaff area.

PATHOLOGY

STEM AND BRANCH DISEASES

Dwarf Mistletoes, Arceuthobium spp.

Dwarf mistletoe species are the most frequently observed and damaging pests in the Southwestern Region. Estimates of annual growth loss range from 100 to 150 million board feet. The three principal hosts and parasitizing dwarf mistletoe species in Arizona and New Mexico are: Ponderosa pine, A. vaginatum subsp. cryptopodum (southwestern dwarf mistletoe); spruce, A. microcarpum; and Douglas-fir, A. douglasii. Southwestern dwarf mistletoe is responsible for the greatest amount of volume loss and mortality.

Forest plans and silvicultural prescriptions throughout the Region stress management of dwarf mistletoe through conventional forest management practices. Forest pest management funds dwarf mistletoe presuppression surveys and suppression projects in both timber stand and recreation areas. The projects are designed to decrease the level of infection in established stands and to protect seedlings in regenerated stands through silvicultural treatments (eg. thinning and overstory removal).

Aspen Stem Canker and Decay Fungi

Aspen stands in Arizona and New Mexico are attacked by a number of stem cankering fungi including: Ceratocystis fimbriata, Hypoxylon mammatum, Encoelia pruinosa (syn. Cenangium singulare), Cytospora chrysosperma, and Cryptosphareria populina. Canker fungi cause significant reductions in growth and vigor in mature aspen stands, as a result of tree mortality, top breakage, cull, and degradation. In many of the Region's aspen stands, 30 percent or more of the stems are affected. In addition, aspen timber type suffers widespread losses to white trunk rot stem decay caused by the false tinder fungus, Phellinus tremulae. White trunk rot incidence is especially significant in mature aspen stands, and cull volumes may range as high as 50 to 60 percent of the total standing volume.

The damage to aspen trees by canker and decay fungi is further increased in campgrounds, due to mechanical wounds incurred during campground establishment and injury from recreationists (Figure 3). During a 1989 survey of the Canjilon Lakes Recreation Area on the Carson National Forest, 947 diseased aspen trees were evaluated. Of these, 654 were standing snags which had died in the past three years. Mortality was primarily attributed to the sooty bark fungus, E. pruinosa (71 percent), and C. chrysosperma (25 percent).

Root Diseases

Root and butt rot pathogens are responsible for approximately ten percent reduction in yield Regionwide. Infections in some mixed conifer stands is greater than 25 percent. Armillaria spp. account for 80 percent of the root disease damage in conifers, especially ponderosa pine. Other root pathogens

Figure 3. Cytospora canker on wounded aspen bole.

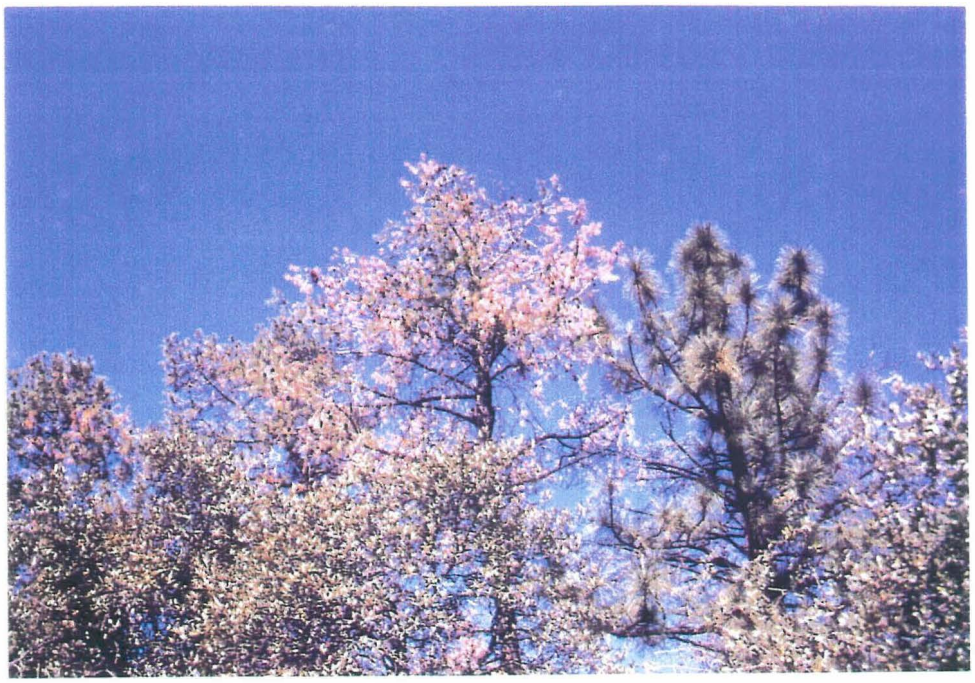

Figure 4. Affected Chihuahua pine located adjacent to healthy Apache pine.

include Fomes annosus, Phaeolus schweinitzii, and Inonotus tomentosus, the latter occurring on spruce. The Southwest looses an estimated 4.8 million cubic feet annually to root disease.

Beginning in 1989, root disease pockets were evaluated in the Big Lake Recreation Area, Springerville, Ranger District, Apache-Sitgreaves National Forests. The information will be used to guide placement of a proposed campground facility.

Foliage Diseases

Lophodermella needle cast, Lophodermella cerina

Extensive areas of ponderosa pine of all ages were infected with this needle cast disease on Apache-Sitgreaves National Forests, Arizona; and Carson, Cibola, Lincoln, and Santa Fe National Forests, and Mescalero Apache Indian Reservation, New Mexico. Regionwide, approximately 111,000 acres of the ponderosa pine forest cover type exhibited needle discoloration caused by this disease in 1989, compared to 21,450 acres reported in 1988.

Abiotic Damage

Drought

Extensive mortality (1,735 acres) of chihuahua pine occurred in many drainages in the Chiricahua Mountains on the Coronado National Forest. The cause was due to an association of severe moisture stress and heavy dwarf mistletoe infection by Arceuthobium gillii. Neighboring apache pine trees, a nonhost species to A. gillii, were not affected (Figure 4). A similar situation was observed in neighboring Chiricahua National Monument.

Nursery Diseases

Sirococcus tip blight, Sirococcus strobilinus

Approximately two percent of the ponderosa pine seedlings were infected with S. strobilinus at the Fort Apache Indian Reservation Nursery.

Table 3. Southwestern Region--Status of Other Diseases in Arizona and New Mexico

Disease	Host	Location	Remarks
STEM AND BRANCH DISEASES			
Comandra blister rust *Cronartium comandrae*	Mondell pine, Ponderosa pine	Arizona	Comandra blister rust was observed on exotic mondell and native ponderosa pines in the Payson, Sedona, and Prescott areas. Damage is typically to individual trees in landscape areas and christmas tree plantations. It has been found on the alternate host, bastard toadflax (*Comandra umbelata*), in southeastern Arizona, but infection on pine there needs to be confirmed.
Fir broom rust *Melampsorella caryophyllacearum*	True firs	Arizona New Mexico	Fir broom rust is widely distributed throughout the subalpine, corkbark, and white fir habitat types in the Southwest. Damages typically consist of top breakage.
Limb rust *Cronartium arizonicum* *Peridermium filamentosum*	Ponderosa pine	Arizona	Small group (2-3 trees) infections were detected on the Apache-Sitgreaves National Forests and the Fort Apache Indian Reservation.
Red rot *Dichomitus squalens*	Ponderosa pine	Arizona, New Mexico	Red rot decay is distributed throughout the Region and is the most common cause of decay in living ponderosa pine in the Southwest.
Red ring rot *Phellinus pini*	Douglas-fir, Ponderosa pine, Spruce, True firs	Arizona, New Mexico	*Phellinus pini*, indigenous to mature and overmature stands of pine and mixed conifers, was scattered in distribution and losses and damage were minimal in most stands. It has also been found in immature pine and mixed conifers in suppressed conditions.
Rust-red stringy rot *Echinodontium tinctorium*	White Fir	Arizona, New Mexico	This fungus was scattered in mature and overmature stands of mixed conifers but caused insignificant losses.
Spruce broom rust *Chrysomyxa arctostaphyli*	Spruce	Arizona, New Mexico	Spruce broom rust was scattered throughout the host type but was of little commercial significance.

Table 3. Southwestern Region--Status of Other Diseases in Arizona and New Mexico--Continued

Disease	Host	Location	Remarks
ROOT DISEASES			
Black stain root disease *Leptographium wageneri* var. *wageneri*	Pinyon pine	Arizona, New Mexico	In addition to the root rot fungi listed above, root disease pockets caused by these organisms are small and scattered throughout the Region.
Schweinitzii butt rot *Phaeolus schweinitzii*	Douglas-fir, True firs	Arizona, New Mexico	
White mottled rot *Ganoderma applanatum*	Aspen	Arizona, New Mexico	
FOLIAGE DISEASES			
Elytroderma disease *Elytroderma deformans*	Pinyon pine, Ponderosa pine	Arizona, New Mexico	Elytroderma disease was widely distributed but at low levels.
Rhabdocline needle cast *Rhabdocline pseudotsugae*	Douglas-fir	New Mexico	Rhabdocline needle cast was detected on Douglas-fir in the Cloudcroft area and on State and private lands bordering the Mescalaro Apache lands and Lincoln National Forest.
ABIOTIC			
Hail damage	Douglas-fir Juniper Pinyon Ponderosa pine Oak	New Mexico	Extensive hail damage occurred on the Pecos Ranger District, Santa Fe National Forest. Although the trees were heavily defoliated by the hail, no permanent damages are expected to occur.
Red Belt Injury	Ponderosa pine	New Mexico	Red belt injury occurred in pockets on the east side of the Sangre de Cristo mountains at about the 8,000 to 8,600 ft. elevation. Hardest hit were ponderosa pine in the Philmont Scout Ranch. Twenty one separate areas of red belt injury covering approximately 10,880 acres were recorded during aerial survey.

PEST COMPLEXES

Aspen defoliation

Acres defoliated	1988	65,075
	1989	17,960

This complex includes the large aspen tortrix, Choristoneura conflictana, and Marssonina blight, Marssonina populi. Regionwide defoliation decreased from 65,075 acres in 1988 to 19,060 acres in 1989. Pockets of defoliation from this pest complex occurred on the Apache-Sitgreaves and Kaibab National Forests and Grand Canyon National Park, Arizona; and the Gila and Santa Fe National Forests and Santa Clara Pueblo and Taos Pueblo Indian Reservations, New Mexico.

Douglas-fir mortality

Trees killed	1988	3,950
	1989	4,100

Mortality attributed to Douglas-fir beetle remained at low levels again in 1989 with 2,633 acres affected. The majority of this mortality occurred on the Carson (870 acres) National Forest and Taos Pueblo (1,660 acres) Indian Reservation in northern New Mexico. Almost all the trees killed were predisposed to attack by a complex of factors including: (1) Past western spruce budworm defoliation, (2) dwarf mistletoe infestation, (3) root diseases, and (4) poor site conditions. Mortality has been occurring in the area for a number of years and peaked in 1987. Widely scattered mortality was also observed on the Apache-Sitgreaves, Coronado, Kaibab, and Tonto National Forests in Arizona. Approximately 700 acres were killed in Colfax County on State and private land; representing a substantial increase from 1988. Volume losses Regionwide from this complex approximated 205,000 cubic feet.

True fir mortality

Trees killed	1988	900
	1989	2,125

True fir mortality caused by the fir engraver beetle, Scolytus ventralis, the primary bark beetle attacking white fir; the western balsam bark beetle, Dryocoetes confusus, commonly found attacking cork bark fir; and associated root diseases including Armillaria spp. and Heterobasidion annosum, increased Regionwide from 690 acres in 1988 to 1,253 acres in 1989. Mortality was widely scattered on the Apache-Sitgreaves, Coconino and Kaibab National Forests, Arizona; and Carson and Cibola National Forests, New Mexico. Volume losses Regionwide from these pest complexes approximated 85,000 cubic feet.

FOREST PEST MANAGEMENT ACTIVITIES IN 1989

Major activities of the Southwestern Region Forest Pest Management (FPM) Staff include detection, evaluation, and suppression of forest pests and technical assistance (including transfer of new technology) to forest land managers on all Federal lands in Arizona and New Mexico. In addition, FPM personnel

cooperate with the States of Arizona and New Mexico in carrying out FPM activities on State and private lands through the Cooperative Forest Pest Action Program.

Detecting and monitoring insect and disease outbreaks and infestations is a major responsibility of the FPM Staff. This is accomplished by systematic aerial surveys, ground examinations, and encouraging forest workers to report unusual and suspected insect and disease occurrences by means of field surveillance kits provided by FPM. Aerial surveys were conducted from July through mid-September over 9.4 million acres of coniferous forests in Arizona and New Mexico to determine the location and extent of damage caused by insects and/or diseases. Upon completion of the surveys, maps showing the location, relative intensity, and kinds of outbreaks were prepared and sent to the respective administrative units.

Ground examinations were made, when necessary, to confirm aerial detection observations, as well as, in response to requests from land managers for detailed information or identification. State pest management specialists conducted aerial and ground surveys on State and private lands in Arizona and New Mexico. A wide variety of insects and diseases were identified by the staff from surveillance reports sent by forest workers from across the Region. Such reports are important for the early detection of potential pest problems, and land managers and forest workers are encouraged to continue prompt reporting of any unusual insect and disease activity.

Forest Pest Management Staff provide technical assistance to National Forests in all phases of project planning, implementation, and monitoring. In 1989, FPM assistance was provided on a variety of projects including timber sales, new campgrounds, several campground rehabilitation projects, and a wilderness management plan.

Forest insect and disease pests occasionally increase to significant levels and cause unacceptable damages to forest resources. These pests are managed by employing a combination of silvicultural, mechanical, biological, and/or chemical suppression strategies.

In 1989 FPM funded dwarf mistletoe suppression projects which included the following activities: Thinning, killing, or removing infested trees to control dwarf mistletoe infestations on a total of 8,609 acres. Presuppression surveys, completed on 57,942 acres, were also funded by FPM. These projects are listed in Table 4.

Forest Pest Management also funded an insect control project in New Mexico which consisted of the suppression of western spruce budworm larval populations in several campgrounds on the Camino Real RD, Carson National Forest, NM. These campgrounds were treated with ground based applications of Bacillus thuringiensis at 8-16 BIUs (Billion International Units) per 100 gallons of water.

Before funding is approved for particular suppression projects, biological evaluations are conducted by FPM Staff. Biological evaluations may also be requested for other insect and disease situations of concern to land managers. Alternatives and recommendations for management are included in the written document. Biological evaluations written for dwarf mistletoe projects to be

carried out in Fiscal Year 1990, and other evaluations are listed below:

Arizona Zone - (1) Pumpkin Dwarf Mistletoe (DM) Control Project, Chalender Ranger District (RD), Kaibab National Forest (NF) (10/20/89); (2) Groom Creek DM Control Project, Bradshaw RD, Prescott NF (10/27/89); (3) Yellow Jacket DM Control Project, Long Valley RD, Coconino NF (09/11/89); (4) Grandview Point / Arizona Trail DM Interpretive Area, Tusyan RD, Kaibab NF (10/12/89); (5) Meads 90 DM Suppression Project, Payson RD, Tonto NF (12/05/89); (6) Abineau DM Suppression Project (12/04/89), (7) Cherry-Meads, Payson RD, Tonto NF (01/06/89, (8) Luna Burn, Alpine RD, Apache-Sitgreaves NFs; (9) Ips Infestation in Blowdown on Alpine RD, Alpine RD, Apache-Sitgreaves NFs (05/18/89); (10) Twig Dieback of Ponderosa Pine, Chevelon RD, Apache-Sitgreaves NFs (08/31/89); (11) Pandora Moth Evaluation, Grand Canyon National Park (07/27/89).

New Mexico Zone - (1) Santa Clara DM Suppression Project, Santa Clara Pueblo Indian Reservation (09/01/89); (2) El Ploso Unit 2 DM Suppression Project, Jicarilla Apache Indian Reservation (08/31/89); (3) Apache Mesa Unit 5 DM Suppression Project, Jicarilla Apache Indean Reservation (8/23/89); (4) Western spruce budworm and aspen defoliation surveys, Santa Fe NF (8/22/89); (5) Evaluation of discolored pines on the Mountainair RD, Cibola NF (7/19/89); (6) Little Tesuque Campground evaluation, Santa Fe NF (7/12/89); (7) Los Pinos Trailhead Survey, Santa Fe NF (7/11/89); (8) Pest Damages in Unit 8, Coyote Canyon Timber Sale, Santa Fe NF (6/13/89); (9) Proposed salvage of dead and dying firs, Lincoln NF (6/8/89); (10) Nambe Pueblo tree damage evaluation, BIA, Northern Pueblo Agency, NM (4/21/89); (11) Western Spruce Budworm Biological Evaluation, 1988, Gila NF (2/8/89); (12) Post Suppression Evaluation of the Benji DM Control Project, El Rito Ranger District, Carson NF (6/6/89).

In 1989, an insect and disease incidence survey of selected recreation sites was initiated to evaluate the overall "health" of proposed and existing campground (CG) areas on the National Forests of Region 3. Both pest conditions and potential hazard trees were evaluated. Southwestern dwarf mistletoe was the main pest detected in these sites, particularly those composed primarily of ponderosa pine. Recommendations for treatments were based upon infection levels and stand structure. The few sites with a large aspen component had a high degree of mortality caused by canker fungi introduced through wounds made during campground establishment and by recreationists. Other detected pests include bark beetles and root rot. The information supplied from these surveys offers pest management considerations for vegetation management plans.

Table 4--Dwarf mistletoe presuppression surveys and suppression projects conducted during 1989 on National Forest and BIA trust lands.

Federal Agency	Presuppression Survey Acres	Suppression Project Acres
National Forest		
Carson	3,500	
Cibola	500	
Coconino	5,647	----
Kaibab	13,950	140
Prescott	1,600	----
Tonto	10,925	4,577
BIA Agency		
Fort Apache	11,000	---
Jicarilla	9,440	---
Mescalero	2,500	392
San Carlos	2,920	---
Southern Pueblos	-----	222
TOTALS	57,942	8,609

RECENT PUBLICATIONS

Hawksworth, F.G., C.G. Shaw III, and B. Tkacz. 1989. Damage and control of diseases of southwestern ponderosa pine. In: Multiresource management of ponderosa pine forests, A. Tecle, W.W. Covington, and R.H. Hamre, tech. coords. Nov. 14-16, 1989. USDA Forest Service General Technical Report RM-185. p 116-129.

Tkacz, B.M. 1989. Incorporating pest management into land management decisions. In: Multiresource management of ponderosa pine forests, A. Tecle, W.W. Covington, and R.H. Hamre, tech. coords. Nov. 14-16, 1989. USDA Forest Service General Technical Report RM-185. p 60-64.